# Male Genitalia of Eristalinae from California

(Syrphidae : Diptera)

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There are a few published papers on studies of the genitalia of Eristalinae. Cole (1927) and Crampton (1944) have contributed substantially on the comparative study of male terminalia of Diptera with references to *Eristalis* and *Helophilus* species. Bean (1949) made good use of male hypopygia in determining the species of *Tubifera* (= *Eristalis*). Zumpt and Heinz (1949) studied the morphology and homology of male terminalia of *Eristalis tenax* (Linn.). The present study was undertaken in an attempt to establish a dependable basis for generic and specific definition in Eristalinae and to supplement the existing literature with fairly constant characters of male terminalia in the taxonomy of this group. A number of characters have been found in the hypopygium, which show marked generic and interspecific variations.

Due to the large number of species present in the Eristalinae and the difficulty in obtaining all of them, the present studies were restricted to those species which are known to occur in California. It is, however, regretted that *Eristalis duncani* Curran and *E. texanus* Hull, although recorded from California, could not be studied due to the inability to secure the material. However, the representatives of genera (*Arctosyrphus, Mallota* and *Meromacrus*) of the subfamily Eristalinae not occurring in California were studied in an effort to present a complete working key of all the genera.

Metcalf's (1921) terminology adopted by Fluke (1951), Stuckenberg (1954), Sedman (1959), and Weisman (1965) has been followed in the present work but the author has preferred to call the trough-shaped sclerite bearing the style and the cerci as the "epandrium," a term proposed by Zumpt and Heinz (1949).

For the preparation of the genitalia studies, the dried and pinned specimens were relaxed in a moist chamber containing water and phenol for 24–48 hours. The postabdomen or genitalia were removed and boiled in 10 per cent KOH for half an hour to two hours, depending upon the degree of chitinisation. Later the structures were neutralized in acetic acid, upgraded and dissected in Canada balsam under a binocular microscope. The diagrams were drawn with the help of

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camera lucida under M5 stereomicroscope. The material was stored in a small vial containing glycerine after study. The vial was then attached to the pin holding the insect from which the genitalia was removed.

## ACKNOWLEDGMENTS

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## DEFINITIONS

The following are the various terms used in the course of this paper (figs. 1 and 11A).

(a) Cerci (C)—a pair of variously shaped structures lying in the membranous area posterior to the epandrium. These are called acrocerci (Berlese, 1909), appendage IV (Newell, 1918), lamellae (Lundbeck, 1916), epiproct (Crampton, 1923), and foreceps superiores (Wesche, 1906).

(b) Styles (S)—a pair of appendages of the ninth segment which are articulated to the caudo-lateral corners of the epandrium. These are also known as mesostyle (Berlese, 1909), appendage I (Newell, 1918), claws (Lundbeck, 1916), foreceps interiores (Wesche, 1906), and surstyli (Fluke, 1951).

(c) Penis sheath (PS)—formed by the ninth sternite and encloses the phallic organs.

(d) Superior lobes (SL)—a pair of more posterior of two pairs of lobes arising from the penis sheath. Stuckenberg (1954) and Nayar (1965) have called these superior claspers and harpagones respectively in Syrphidae.

(e) Epandrium (E)—the modified ninth tergum.

(f) Inferior lobes (IL)—the anterior pair of two pairs of lobes arising from the penis sheath. These may be absent in some cases. Stuckenberg (1954) preferred to call these inferior claspers.

(g) Chitinous box (CB, fig. 65)—penis proper of Fluke (1951) or the more commonly called aedeagus or the phallus bearing the membranous ejaculatory hood (EH) at its distal end.

For a better understanding of the homologies of male genitalia,

students of morphology are referred to the splendid works of Crampton (1923 and 1944) and Cole (1927).

## KEY TO THE GENERA OF ERISTALINAE BASED ON GENITALIA OF MALES

1. Styles short and broad ..... 2
   Styles long and tubular ..... 5
2. Inferior lobes present ..... 3
   Inferior lobes absent ..... 4
3. Superior lobes long, tubular, with hood of bristles near apex (fig. 61) ..... *Merodon* Meigen
   Superior lobes long, flask-like, apex somewhat bifid (fig. 59) ..... *Asemosyrphus* Bigot
4. Styles bifid at apex; superior lobes broadly capitate terminally (figs. 56 and 57) ..... *Meromacrus* Rondani
   Styles not bifid at apex, terminally with extremely sharp conical projection; superior lobes flask-like at base, apical part cylindrical and chitinized (figs. 62, 63, and 64) ..... *Polydontomyia* Williston
5. Cerci nearly kidney-shaped ..... 6
   Cerci kidney-shaped or triangular ..... 7
6. Inferior lobes long, narrow and tubular (fig. 1) (except *Eristalis latifrons*, *E. alhambra*, *E. meigeni*, and *E. testaceicornis*) ..... *Eristalis* Latreille
   Inferior lobes short and broad (fig. 67) ..... *Arctosyrphus* Frey
7. Styles about twice the depth of the epandrium (figs. 52 and 54) ..... *Mallota* Meigen
   Styles about the depth of epandrium (figs. 42, 45, 47, and 50) ..... *Helophilus* Meigen

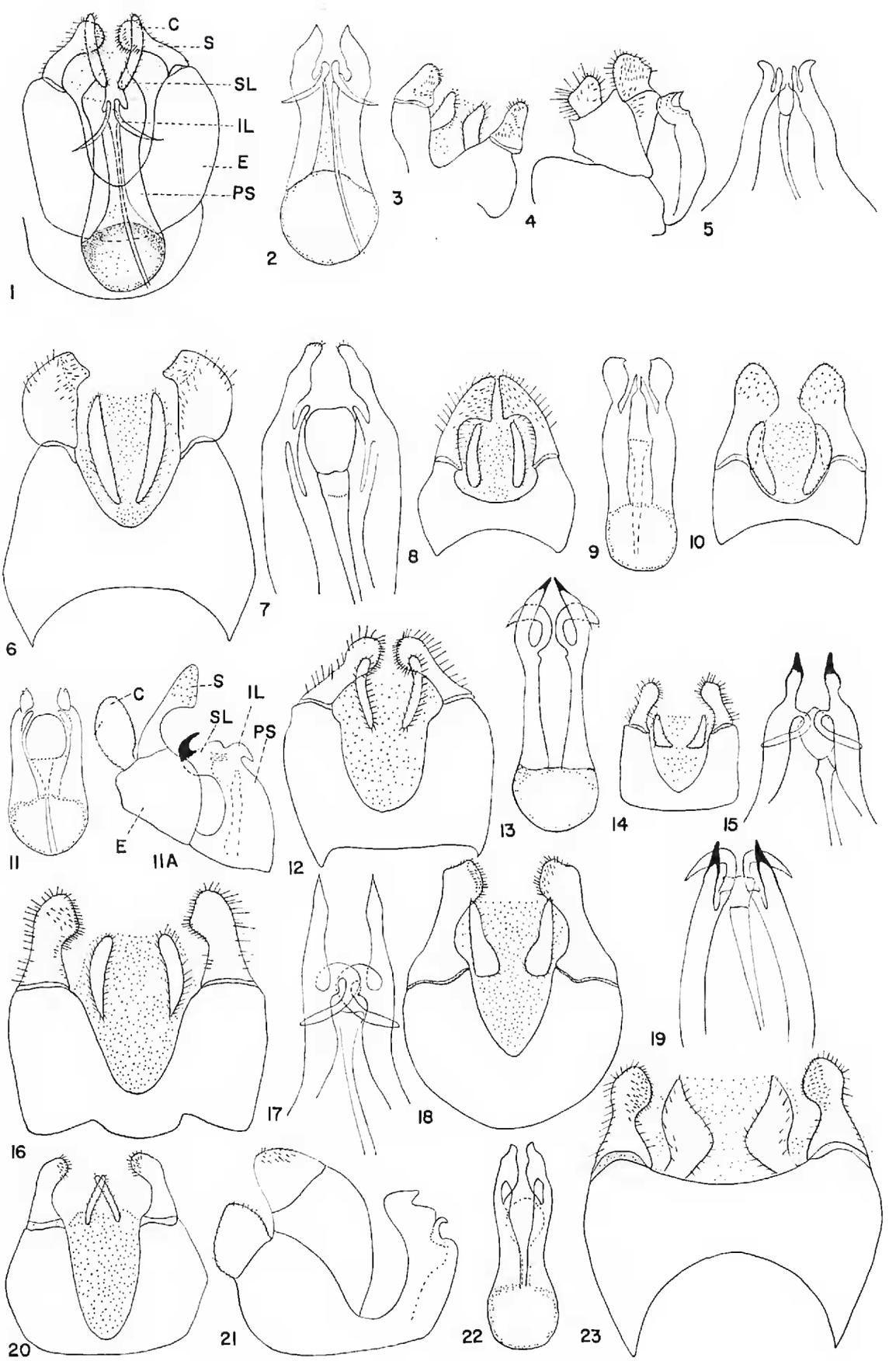
## DESCRIPTIONS OF MALE GENITALIA

*Eristalis tenax* (Linn.) (figs. 3, 4, and 5).—Epandrium horseshoe-shaped, about twice as wide as long with lower corners rounded. Styles lobe-like, nearly half as wide at apex as at base with an inner median notch; apical part and inner half beset with small bristles. Cerci kidney-shaped with long bristles. Superior lobes linear in basal two-thirds and curved outwards apically. Inferior lobes of uniform width.

*Eristalis obsoletus* Wied. (figs. 6 and 7).—Epandrium about one and a half times as broad as long with lower corners produced and acute. Styles as broad as long except apical triangular part; outer border sharply convex, inner concave; long setae present along the upper outer margin of broad basal part of style. Cerci kidney-shaped. Superior lobes broad in middle, narrowing both at base and apex with few small bristles at rounded apical end. Inferior lobes long, linear.

*Eristalis triangularis* Giglio-Tos (figs. 8 and 9).—Epandrium about one and a half times as wide as long with lower corners slightly produced and acute. Styles almost as long as depth of epandrium, broad at base, narrowing in middle and extremely broad towards apex; long bristles present along outer margin and pubescent all over. Cerci kidney-shaped, slightly broad at base and gradually narrowing apically. Superior lobes mango-shaped, narrow at base and pointed apically. Inferior lobes long, tubular in basal two-thirds and conical apically.

*Eristalis alhambra* Hull (figs. 10 and 11).—Epandrium about twice as wide as long with lower corners slightly produced and acute. Styles long, about one and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a half times the depth of epandrium, rounded at apex with minute pubescence in apical part. Cerci kidney-shaped, nearly as long as epandrium with small bristles along borders. Superior lobes small, broad at base, produced apically into chitinized horn-like structures. Inferior lobes small, tubular. Chitinous box oval with two elongated sclerotized pieces.

*Eristalis dimidiatus* Wied. (figs. 12 and 13).—Epandrium about one and a half times as wide as long with lower corners slightly produced and acute. Styles long, rounded at apex, apical part partially constricted from lower tubular stalk. Outer border and rounded part of styles beset with bristles, bristles more dense on inner margin. Cerci kidney-shaped. Superior lobes apically ending in conical chitinized structure. Inferior lobes sharply curved outwards with apices like superior lobes.

*Eristalis temporalis* Thomson (figs. 1 and 2).—Epandrium slightly longer than wide with rounded cephalic margin. Styles typically like those of *E. dimidiatus* but curved more deeply on the inside. Cerci typical for group but slightly projecting above apices of styles. Superior lobes have their upper posterior corners produced into conical projections. Inferior lobes long, tubular, projecting downwards and outward.

*Eristalis occidentalis* Williston (figs. 14 and 15).—Epandrium a little less than one and a half times as wide as long with cephalic corners rounded. Styles like that of *E. temporalis*. Cerci somewhat kidney-shaped, projecting a little above bases of styles. Superior lobes broad in middle and narrowed basally and apically; conical apices highly chitinized. Inferior lobes more like those in *E. temporalis* but slightly broadening from base to tip. Chitinous box oval.

*Eristalis bastardii* (Macquart) (figs. 16 and 17).—Epandrium about twice as wide as long with median depression on cephalic margin, lower corners acute. Styles somewhat like *E. dimidiatus* but distinctly bulging into knob-like projections subapically on inner borders. Cerci kidney-shaped, broad apically and narrow

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FIG. 1. *Eristalis temporalis* Thomson (male genitalia in situ) ventral view. (See text for explanation of characters.) FIG. 2. *E. temporalis* Thomson, penis sheath (ventral view). FIG. 3. *E. tenax* (Linn.), epandrium (dorsal view). FIG. 4. *E. tenax* (Linn.), male genitalia (lateral view). FIG. 5. *E. tenax* (Linn.), penis sheath (ventral view). FIG. 6. *E. obsoletus* Wied., epandrium (dorsal view). FIG. 7. *E. obsoletus* Wied., penis sheath (ventral view). FIG. 8. *E. triangularis* G. T., epandrium (dorsal view). FIG. 9. *E. triangularis* G. T., penis sheath (ventral view). FIG. 10. *E. alhambra* Hull, epandrium (dorsal view) FIG. 11. *E. alhambra* Hull, penis sheath (ventral view). FIG. 11a. *E. alhambra* Hull, male genitalia (lateral view). (See text for explanation of characters.) FIG. 12. *E. dimidiatus* Wied., epandrium (dorsal view). FIG. 13. *E. dimidiatus* Wied., penis sheath (ventral view). FIG. 14. *E. occidentalis* Will., epandrium (dorsal view). FIG. 15. *E. occidentalis* Will., penis sheath (ventral view). FIG. 16. *E. bastardii* Macq., epandrium (dorsal view). FIG. 17. *E. bastardii* Macq., penis sheath (ventral view). FIG. 18. *E. latifrons* Loew, epandrium (dorsal view). FIG. 19. *E. latifrons* Loew, penis sheath (ventral view). FIG. 20. *E. arvorum* (Fab.), epandrium (dorsal view). FIG. 21. *E. arvorum* (Fab.), male genitalia (lateral view). FIG. 22. *E. arvorum* (Fab.), penis sheath (ventral view). FIG. 23. *E. anthophorinus* (Fallen), epandrium (dorsal view).

basally. Superior lobes long, tubular (rocket-shaped), sharply pointed apically. Inferior lobes long, tubular, directed downwards and outwards.

*Eristalis latifrons* Loew (figs. 18 and 19).—Epandrium a little more than about one and a half times as wide as long with rounded cephalic margin. Styles almost as long as depth of epandrium, broad both basally and apically but sharply narrow medially. Styles curve inwards, densely covered dorsoapically by coarse bristles along inner half. Cerci somewhat kidney-shaped, broad basally and narrowing towards apex. Superior lobes characteristically knife-like in shape as described by Bean (1949); apical part highly chitinized, tapering into sharp point. Inferior lobes long, tubular, directed upwards and outwards. Chitinous box quadrangular.

*Eristalis arvorum* (Fab.) (figs. 20, 21, and 22).—Epandrium about one and a half times as wide as long with cephalic margin rounded. Styles nearly rounded at apex, sharply flexed medially on inner borders, curving inwards; small bristles present along apical inner surface. Cerci small, narrow, linear, lobed. Superior lobes flask-like at basal two-thirds, apical part narrow, tips blunt; appearing bifid in lateral view. Inferior lobes small, lobe-like. Penis sheath about as long as epandrium. Ejaculatory hood somewhat rounded.

*Eristalis anthophorinus* (Fallen) (figs. 23 and 24).—Epandrium about twice as wide as long with lower corners sharply produced and acute. Styles about half as long as depth of epandrium, broad basally, narrowing in middle and rounded apically; with long bristles along outer margin, short pubescence on inner rounded part and few medium sized bristles on lower inner border. Cerci somewhat broad medially and narrow at ends. Superior lobes tubular, narrowing towards apex. Inferior lobes long, curving outwards and downwards.

*Eristalis bardus* (Say) (figs. 25, 26, and 27).—Epandrium about one and a half times as wide as long with lower corners produced and acute. Styles long, about two-thirds the depth of epandrium, rounded at apex; beset with prominently large bristles along inner half. Cerci long, kidney-shaped with long bristles along the borders. Superior lobes extremely long, uniformly tubular, ending in conical point. Inferior lobes about half as long as the superior lobes, tubular, pointing downwards and outwards. Penis sheath cylindrical, about as long as depth of epandrium. Chitinous box oval.

*Eristalis arbustorum* (Linn.) (figs. 28 and 29).—Epandrium about three times as wide as long with lower corners highly produced and acute. Styles long, tubular, nearly of uniform width throughout, apices converging over cerci; inner margin with long bristles. Cerci kidney-shaped, about as long as styles with pubescence along borders. Bean (1949), however, reported styles as being lobed. Superior lobes long, narrowed from base to apex and slightly curved outwards apically. Inferior lobes moderately long, surrounding tip of chitinous box.

*Eristalis hirtus* Loew (figs. 30, 31, and 32).—Epandrium about one and a half times as wide as long with lower corners slightly produced and rounded. Styles lobe-like, nearly twice as wide at base as at apex, apical end rounded; small bristles present along dorsoapical and inner borders. Cerci about four times as broad at base as at apex. Superior lobes with convex outer and inner borders, produced into sharp point apically. Inferior lobes like those in *E. bastardii* but narrower at base. Penis sheath slightly longer than epandrium.

*Eristalis meigenii* Wied. (figs. 33, 34, and 35).—Epandrium slightly less than one and a half times as wide as long with the lower corners produced and rounded. Styles long, tubular, very much like those of *E. arbustorum* with bristles along

inner margin. Cerci kidney-shaped, nearly as long as styles with 5 distinct markings (probably sensillae) on basal part. Superior lobes extremely long, blade-like, produced into sharp conical point apically. Inferior lobes small, almost oval in lateral view. Ejaculatory hood dome-shaped.

*Eristalis testaceicornis* Macquart (figs. 36, 37, and 38).—Epandrium about one and a half times as wide as long with lower corners slightly produced and acute. Styles long, tubular, nearly as long as depth of epandrium, broad basally and narrowly converging apically. Cerci somewhat kidney-shaped, long, broad basally and cone-like apically. Superior lobes long, narrow and cylindrical in basal half and flask-like apically. Inferior lobes rather small and lobe-like. Ejaculatory hood quadrangular.

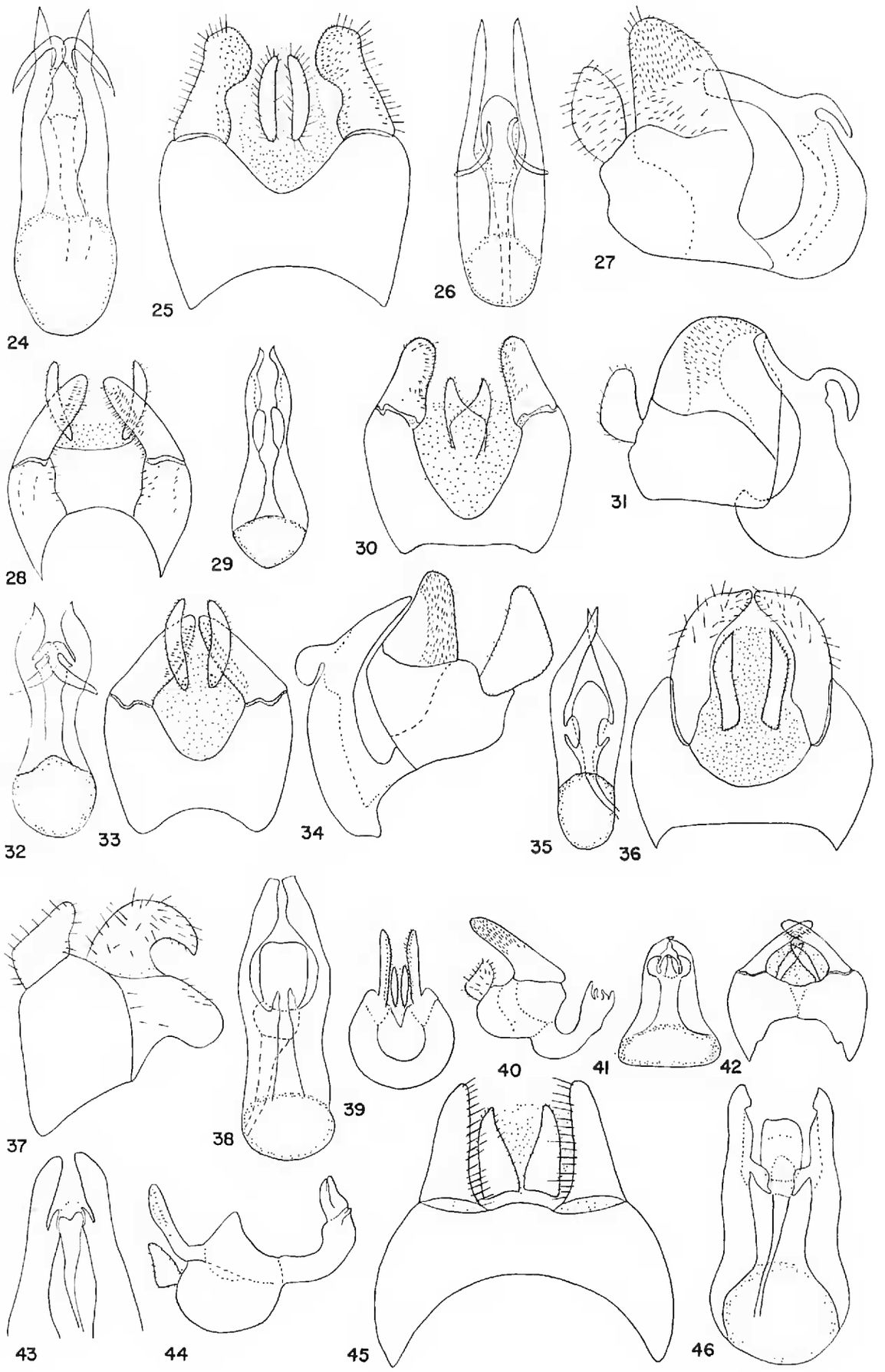
*Eristalis* (*Lathrophthalmus*) *aeneus* (Scopoli) (figs. 39, 40, and 41).—Epandrium about as long as wide with cephalic margin circular. Styles long, tubular, apical part rounded in lateral view; apex about one-third as wide as base. Inner borders of styles with numerous small black hairs. Cerci slightly broad at base and narrow apically.

## Discussion of Male Genitalia in Eristalis Latreille and Groupings

Seventeen species have been examined showing marked variations from the standpoint of evolution, but certain distinct similarities suggest that they belong to the same genus. The long styles, kidney-shaped cerci and long linear inferior lobes are somewhat fairly constant features of the genus, but minor variations even in these are not ruled out. Three groups, (i) Tenax group, (ii) Dimidiatus group, and (iii) Arbustorum group, are suggested. The Tenax group [*E. tenax* (Linn.), *E. obsoletus* Wied. and *E. triangularis* G. T.] is characterized by the long and broad styles; the Dimidiatus group [*E. dimidiatus* Wied., *E. temporalis* Thomson, *E. occidentalis* Williston, *E. bastardii* Macq., *E. latifrons* Loew, *E. arvorum* Fab., *E. anthophorinus* (Fall.), *E. alhambra* Hull, and *E. bardus* (Say)] has long styles, rounded at apex; while the Arbustorum group [*E. arbustorum* Linn., *E. hirtus* Loew, *E. meigenii* Wied., and *E. testaceicornis* Macquart] bear long and tubular styles.

(i) The Tenax group. The commonly occurring species *E. tenax* (figs. 3, 4, and 5) can be easily distinguished in the group by the epandrium being twice as wide as long; superior lobes linear, curved at the apex and inferior lobes linear and narrow. The species *E. obsoletus* (figs. 6 and 7) and *E. triangularis* (figs. 8 and 9) present similarities in the form of epandrium, styles and inferior lobes but are distinct from one another by the structure of superior lobes.

(ii) The Dimidiatus group. There is a wide range of variation of various structures in the species of this group. The species *E. temporalis* (fig. 2), *E. bastardii* (fig. 17), *E. occidentalis* (fig. 15), and *E. bardus* (fig. 26) have long, tubular, inferior lobes, projecting downwards and outwards, while *E. dimidiatus* (fig. 13), *E. latifrons* (fig. 19), and *E.*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*anthophorinus* (fig. 24) show these projecting upwards and outwards. The species *E. arvorum* (fig. 22) and *E. alhambra* (fig. 11) are exceptions with small, narrow, lobe-like inferior lobes. The species *E. temporalis* (figs. 1 and 2) and *E. occidentalis* (figs. 14 and 15) are closely related in having rounded cephalic margin of the epandrium, but the long, lobe-like superior lobes of the former are in sharp contrast to the long, medially broad superior lobes of the latter. *Eristalis bastardii* (figs. 16 and 17) and *E. bardus* (figs. 25 and 26) are distinguishable by the structure of the epandrium, styles and the superior lobes. The superior lobes are long, tubular and sharply pointed in *E. bastardii* and long and uniformly tubular in *E. bardus*. The styles are about one and a half times as long as the epandrium in the former and about two-thirds the depth of the epandrium in the latter. On the other hand, the species *E. dimidiatus* (figs. 12 and 13) and *E. latifrons* (figs. 18 and 19) are easily distinguished by the produced lower corners of the epandrium and the acute and long conical superior lobes in *E. dimidiatus*. The latter species has the cephalic margin of the epandrium rounded and the superior lobes are knife-like. The species *E. anthophorinus* (fig. 24) is unique in the group by having small, tubular, superior lobes. *Eristalis alhambra* (fig. 11) and *E. arvorum* (fig. 22) differ in that the former has small superior lobes, produced into horn-like structures apically while the latter has long, superior lobes which are flask-like at the basal two-thirds and narrowed apically.

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FIG. 24. *Eristalis anthophorinus* (Fallen), penis sheath (ventral view). FIG. 25. *E. bardus* (Say), epandrium (dorsal view). FIG. 26. *E. bardus* (Say), penis sheath (ventral view). FIG. 27. *E. bardus* (Say), male genitalia (lateral view). FIG. 28. *E. arbustorum* (Linn.), epandrium (ventral view). FIG. 29. *E. arbustorum* (Linn.), penis sheath (ventral view). FIG. 30. *E. hirtus* Loew, epandrium (dorsal view). FIG. 31. *E. hirtus* Loew, male genitalia (lateral view). FIG. 32. *E. hirtus* Loew, penis sheath (ventral view). FIG. 33. *E. meigenii* Wied., epandrium (dorsal view). FIG. 34. *E. meigenii* Wied., male genitalia (lateral view). FIG. 35. *E. meigenii* Wied., penis sheath (ventral view). FIG. 36. *E. testaceicornis* Macq., epandrium (dorsal view). FIG. 37. *E. testaceicornis* Macq., epandrium (lateral view). FIG. 38. *E. testaceicornis* Macq., penis sheath (ventral view). FIG. 39. *E.* (*Lathrophthalmus*) *aeneus* (Scopoli), epandrium (dorsal view). FIG. 40. *E.* (*Lathrophthalmus*) *aeneus* (Scopoli), male genitalia (lateral view). FIG. 41. *E.* (*Lathrophthalmus*) *aeneus* (Scopoli), penis sheath (ventral view). FIG. 42. *Helophilus* (*Helophilus*) *latifrons* Loew, epandrium (dorsal view). FIG. 43. *Helophilus* (*Helophilus*) *latifrons* Loew, penis sheath (ventral view). FIG. 44. *Helophilus* (*Helophilus*) *latifrons* Loew, male genitalia (lateral view). FIG. 45. *Helophilus* (*Helophilus*) *fasciatus* Walker, epandrium (dorsal view). FIG. 46. *Helophilus* (*Helophilus*) *fasciatus* Walker, penis sheath (ventral view).

(iii) The Arbustorum group. There is still more diversity of form and structures in the members of this group. The species *E. hirtus* (fig. 30) and *E. meigenii* (fig. 33) are closely related by the similar form of the epandrium; *E. meigenii* (fig. 35) and *E. testaceicornis* (fig. 38) by the similar, small lobe-like inferior lobes, and *E. arbustorum* (fig. 28) and *E. meigenii* (fig. 33) by similar styles. All of these are well marked by the distinct form of the superior lobes. The long, tubular inferior lobes pointing downward and outward and flask-shaped superior lobes of *E. hirtus* (fig. 32) will easily distinguish it from *E. arbustorum* (fig. 29). In *E. arbustorum* the inferior lobes are long, straight and tubular and the superior lobes are long, narrow and outwardly curved. The species *E. meigenii* (fig. 35) with long bladelike superior lobes is distinct from *E. testaceicornis* (fig. 38), which has the superior lobes long, narrow, and cylindrical at the basal half and flask-like at the apical part. The species *E.* (*Lathrophthalmus*) *aeneus* (Scopoli) (figs. 39 and 41) shows marked similarity in the structures of styles and inferior lobes with the members of the *E. arbustorum* group but is unique in having the epandrium about as wide as long and the superior lobes long and tubular.

There are, however, certain points of similarity in structure of various parts amongst these groups. The species *E. obsoletus* (fig. 7) of the Tenax group has similar superior lobes to *E. occidentalis* (fig. 15) of the Dimidiatus group, whereas *E. arvorum* (fig. 22) of the Dimidiatus group bears identical inferior lobes to those of *E. meigenii* (fig. 35) and *E. testaceicornis* (fig. 38) of the Arbustorum group. Additionally, *E. hirtus* (fig. 32) of the Arbustorum group too has similar inferior lobes to *E. temporalis* (fig. 2), *E. bastardii* (fig. 17) and *E. occidentalis* (fig. 15) of the Dimidiatus group. In view of the similarities and differences of species within a group and of intergroup relationships, it is obvious that the various groups proposed are not firmly established.

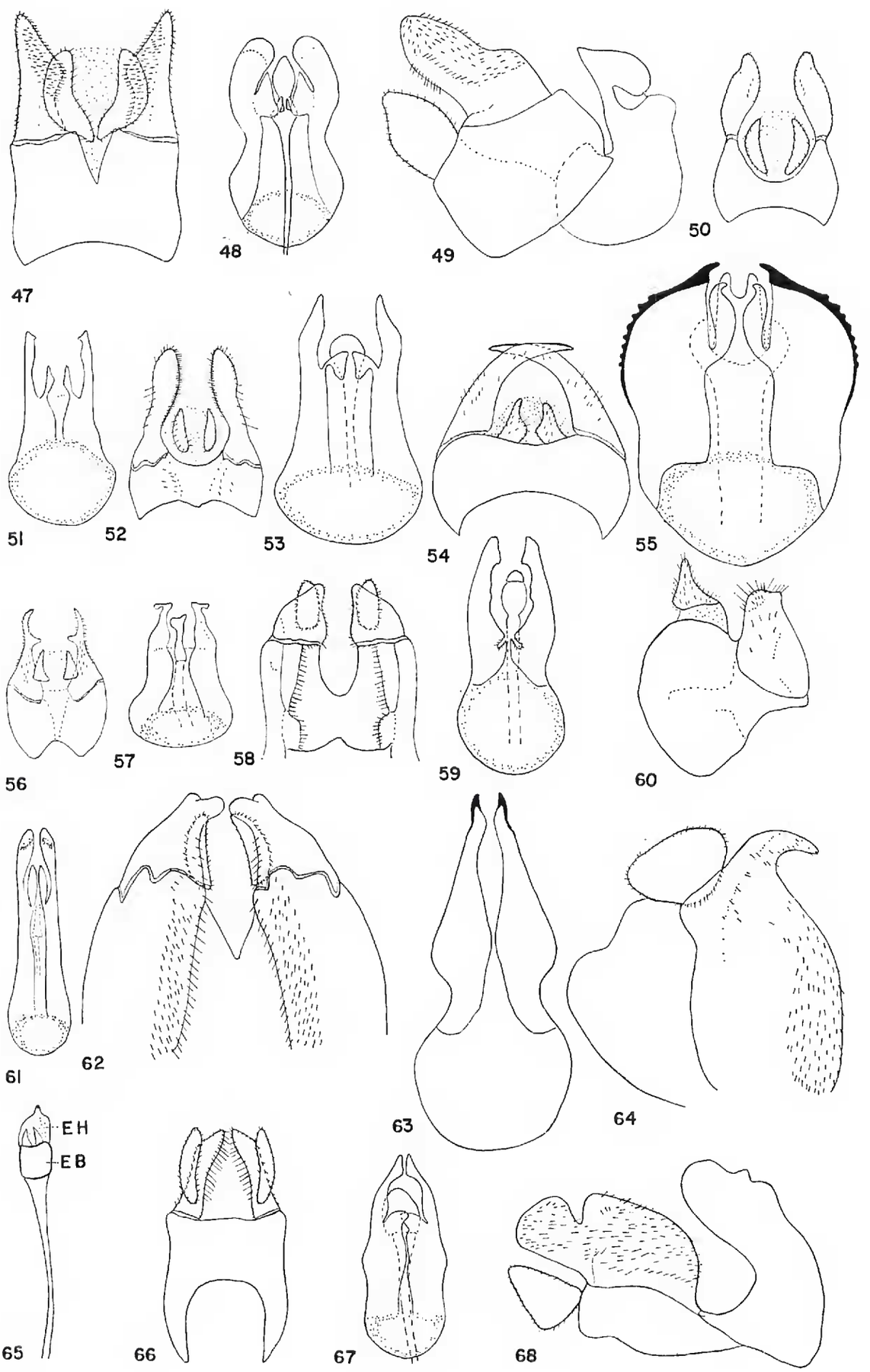
## KEY TO THE SPECIES OF ERISTALIS BASED UPON MALE GENITALIA

1. Styles long, broad lobed ..... 2
   Styles long, narrow, and tubular ..... 4
2. Epandrium twice as wide as long; styles half as wide at apex as at base (fig. 3) ..... *tenax* (Linn.)
   Epandrium one and a half times as wide as long ..... 3
3. Superior lobes broad in middle and narrow at both ends; styles as broad as long except apical part (fig. 7) ..... *obsoletus* Wied.
   Superior lobes mango-shaped; styles as long as depth of epandrium (figs. 8 and 9) ..... *triangularis* G. T.
4. Styles rounded at apex ..... 5
   Styles not rounded at apex ..... 13

5. Inferior lobes small, narrow, and lobe-like ..... 6
   Inferior lobes long, narrow and tubular ..... 7
6. Superior lobes small, produced into horn-like structures apically (fig. 11) ..... *alhambra* Hull
   Superior lobes long, flask-like in basal two-thirds and cylindrical apically (fig. 22) ..... *arvorum* (Fab.)
7. Inferior lobes projecting downwards and outwards ..... 8
   Inferior lobes projecting upward and outwards ..... 11
8. Epandrium with cephalic margin rounded ..... 9
   Epandrium with lower corners of cephalic margin produced and acute ..... 10
9. Superior lobes long, broad and lobe-like (fig. 2) ..... *temporalis* Thomson
   Superior lobes long, broad in middle and narrowed at both ends (fig. 15) ..... *occidentalis* Will.
10. Epandrium twice as wide as long with median depression on cephalic border. Styles about one and a half times the depth of epandrium and superior lobes sharply pointed apically (figs. 16 and 17) ..... *bastardii* Macq.
    Epandrium about one and a half times as wide as long with no median depression on cephalic border and superior lobes long, uniformly tubular (figs. 25 and 26) ..... *bardus* (Say)
11. Styles about half the depth of epandrium ..... 12
    Styles as long as depth of epandrium; superior lobes knife-like (figs. 18 and 19) ..... *latifrons* Loew
12. Superior lobes long, tubular in basal two-thirds and sharply conical and chitinized apically (fig. 13) ..... *dimidiatus* Wied.
    Superior lobes small, tubular and pointed apically (fig. 24) ..... *anthophorinus* (Fallen)
13. Inferior lobes long and tubular ..... 14
    Inferior lobes small and lobe-like ..... 15
14. Superior lobes long, narrow, curved outward apically and inferior lobes straight (fig. 29) ..... *arbustorum* (Linn.)
    Superior lobes flask-like and inferior lobes projecting downwards and outwards (fig. 32) ..... *hirtus* Loew
15. Epandrium about one and a half times as wide as long, lower corners of cephalic margin produced and acute ..... 16
    Epandrium about as wide as long, cephalic margin rounded (fig. 39) ..... *aeneus* (Scopoli)
16. Superior lobes long, blade-like with apical part short and conical (fig. 35) ..... *meigenii* Wied.
    Superior lobes long, narrow, cylindrical in basal half and flask-like apically (fig. 38) ..... *testaceicornis* Macq.

## Descriptions of Male Genitalia

*Helophilus* (*Helophilus*) *latifrons* Loew (figs. 42, 43, and 44).—Epandrium about twice as wide as long with lower corners extremely produced and acute. Styles, long, tubular, about as long as epandrium, nearly half as wide at apex as at base, sharply curving inwards with few bristles along apical part. Cerci somewhat triangular with prominent bristles along borders. Superior lobes conical, outer margin convex and inner almost straight. Inferior lobes small, triangular,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outer border convex and inner concave. Chitinous box quadrangular with lateral walls flexed inwards.

*Helophilus* (*Helophilus*) *fasciatus* Walker (figs. 45 and 46).—Epandrium about twice as wide as long with lower corners extremely produced and acute. Styles long, tubular, about two and a half times as wide at base as at apex with extremely long bristles along entire inner margin. Cerci large, triangular, about five times as broad at base as at apex. Superior lobes long, cylindrical in basal two-thirds, produced into knob-like structure apically. Inferior lobes small and quadrangular. Penis sheath about as long as depth of epandrium.

*Helophilus* (*Anasimyia*) *perfidiosus* (Hunter) (figs. 47, 48, and 49).—Epandrium about one and a half times as wide as long with lower corners slightly produced and rounded. Styles about as long as depth of epandrium, tubular in basal two-thirds and triangular apically. A median knob-like structure faces inward on styles with small bristles present along inner surface from apex to base. Cerci broad, kidney-shaped, narrowed basally and rounded apically. Superior lobes long, gradually widening from base to a little below apex, lobes appear somewhat flask-like in lateral view. Inferior lobes small, caudate. Penis sheath nearly as deep as ninth tergum, ejaculatory hood dome-shaped. Chitinous box with two triangular, sclerotized pieces at its base.

*Helophilus* (*Lunomyia*) *cooleyi* (Scamans) (figs. 50 and 51).—Epandrium about one and a half times as wide as long with lower corners slightly produced and acute. Styles about as long as depth of epandrium, tubular, narrowed at both base and apex; minutely pubescent along borders. Cerci kidney-shaped, about half as long as styles with large bristles along borders. Superior lobes long, tubular, of uniform width in basal half, broadening a little with terminal hook below apex. Inferior lobes broad at middle and narrowed both basally and apically.

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FIG. 47. *Helophilus* (*Anasimyia*) *perfidiosus* (Hunter), epandrium (dorsal view). FIG. 48. *Helophilus* (*Anasimyia*) *perfidiosus* (Hunter), penis sheath (ventral view). FIG. 49. *Helophilus* (*Anasimyia*) *perfidiosus* (Hunter), male genitalia (lateral view). FIG. 50. *Helophilus* (*Lunomyia*) *cooleyi* (Seamans), epandrium (dorsal view). FIG. 51. *Helophilus* (*Lunomyia*) *cooleyi* (Seamans), penis sheath (ventral view). FIG. 52. *Mallota sackeni* Williston, epandrium (dorsal view). FIG. 53. *Mallota sackeni* Williston, penis sheath (ventral view). FIG. 54. *Mallota* sp., epandrium (dorsal view). FIG. 55. *Mallota* sp., penis sheath (ventral view). FIG. 56. *Meromacrus acutus* (Fab.), epandrium (dorsal view). FIG. 57. *Meromacrus acutus* (Fab.), penis sheath (ventral view). FIG. 58. *Asemosyrphus polygrammus* (Loew), epandrium (ventral view). FIG. 59. *Asemosyrphus polygrammus* (Loew), penis sheath (ventral view). FIG. 60. *Merodon equestris* (Fab.), epandrium (lateral view). FIG. 61. *Merodon equestris* (Fab.), penis sheath (ventral view). FIG. 62. *Polydontomyia curvipes* (Wied.), epandrium (ventral view). FIG. 63. *Polydontomyia curvipes* (Wied.), penis sheath (ventral view). FIG. 64. *Polydontomyia curvipes* (Wied.), epandrium (lateral view). FIG. 65. *Polydontomyia curvipes* (Wied.), aedeagus (dorsal view). (See text for explanation of characters.) FIG. 66. *Arctosyrphus willingii* (Smith), epandrium (dorsal view). FIG. 67. *Arctosyrphus willingii* (Smith), penis sheath (ventral view). FIG. 68. *Arctosyrphus willingii* (Smith), male genitalia (lateral view).

## KEY TO THE SUBGENERA OF HELOPHILUS BASED ON MALE GENITALIA

1. Epandrium about twice as wide as long, lower corners of cephalic margin highly produced and acute (figs. 42 and 45) ..... *Helophilus* Meigen
   Epandrium about one and a half times as wide as long, lower corners of cephalic margin slightly produced and acute ..... 2
2. Superior lobes long, gradually widening from base to a little below the apex and inferior lobes small and caudate (fig. 48) ..... *Anasimyia* Schiner
   Superior lobes long, tubular, of uniform width in basal half, broadening a little below apex and inferior lobes broad at middle and narrowed at ends (fig. 51) ..... *Lunomyia* Curran and Fluke

## DESCRIPTIONS OF MALE GENITALIA

*Mallota sackeni* Williston (figs. 52 and 53).—Epandrium about three times as wide as long with lower corners slightly produced and acute. Styles extremely long with sharp inward curvature near base; dorsoanterior margin folded ventrally, beset with numerous small bristles and outer border with a row of slightly long bristles. Cerci about as long as depth of epandrium, broad at base and pointed apically with long bristles along margins. Superior lobes long, broad at middle and narrowed both basally and apically. Inferior lobes small, about five times as broad at apex as at base. Ejaculatory hood rounded.

*Mallota* sp. (figs. 54 and 55).—Epandrium about a little more than twice as wide as long with lower corners produced and acute. Styles long, sickle-shaped with outer margin convex and inner concave; sparsely hairy. Styles acutely pointed and sclerotized terminally. Cerci small, broad basally and pointed apically. Superior lobes broad, conical, produced into claw-like process apically. Inferior lobes long, sharply hooked apically. Penis sheath distinctly oval, upper outer margin highly chitinized and serrated.

*Meromacrus acutus* (Fab.) (figs. 56 and 57).—Epandrium nearly as broad as long with lower corners produced and rounded. Styles as long as depth of epandrium, broad at base narrowing apically, apex distinctly bifid. Cerci small, triangular. Superior lobes flask-like basally with narrow neck, broadly capitate at apex. Inferior lobes absent. Penis sheath about twice as long as epandrium and ejaculatory hood triangular.

*Asemosyrphus polygrammus* (Loew) (figs. 58 and 59).—Epandrium about one and a half times as wide as long. Styles triangular, broad basally and narrow apically; inner margin rolled ventrally. Styles with bristles along inner margin from apex to base. Cerci oval with hair along borders. Superior lobes long, of characteristic shape for genus. Inferior lobes extremely small, lobe-like. Chitinous box quadrangular and ejaculatory hood semispherical.

*Merodon equestris* (Fab.) (figs. 60 and 61).—Epandrium about one and a half times as long as wide with rounded cephalic margin. Styles about twice as broad at base as at apex; dorsoanterior and apical border beset with long bristles. Cerci triangular, base about twice as broad as apex; small bristles present all over surface. Superior lobes extremely long, cylindrical with hood of bristles near apical part. Inferior lobes long, narrow and oval.

*Polydontomyia curvipes* (Wied.) (figs. 62, 63, 64, and 65).—Epandrium about twice as wide as long. Styles extremely broad from base to apex, apex with extremely sharp turned conical process; hairy along inner concave margins. Cerci kidney-shaped, about as long as styles. Superior lobes long, flask-like at base,

gradually narrowing towards apex; extreme tip highly chitinized. Inferior lobes lacking. Chitinous box quadrangular, terminally with pair of small, triangular, chitinized pieces which possibly support the membranous ejaculatory hood in front.

*Arctosyrphus willingi* (Smith) (figs. 66, 67, and 68).—Epandrium about as long as wide with lower corners greatly produced and acute. Styles long, tubular with long bristles along inner margin. Cerci kidney-shaped. Superior lobes long, flask-like. Inferior lobes small, triangular. Ejaculatory hood oval.

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